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EFFECT OF TEMPERATURE ON FOODS

Our Food

With the exception of milk most of the items we eat as food are simply other plants, animals and fish or even fungi and other life forms not designed to be food but simply part of our environment. They come from the land, sea or fresh water. They are exposed to all the substances that make up our location. There is a great deal of competition for the organic compounds that make up our food. As we know birds and insects will invade fruits and vegetables and small fish will eat bigger fish.

It is our experience that foods change as they age. Bananas change from green to yellow and ultimately black, and fruits soften eventually and other items lose their texture and become fibrous or tough. Foods will respond to the environment immediately so if they are in a low relative humidity environment they will wilt and dry out. If they are in a high relative humidity environment they will pick moisture. However most deterioration occurs because other life forms attack the food at the same time.

In the middle of the 18th century a Frenchman by the name of Louis Pasteur discovered the very small world that was unknown to us for most of human existence. We now know that this micro-world is made up of bacteria, yeasts and moulds and of course very obvious to us viruses.

Let us play down the importance of viruses on our food because they need to move from a living cell (human, animal0 or fish) to another and do not survive more than a few days without. But as they can be transferred by dirty water and other organic matter there are instances where viruses are sometimes present in food – the shellfish, such as oysters that are not cooked. However, as with all bacteria yeasts and moulds and viruses they can gain access by contamination resulting from careless handling or from contaminated water and surfaces.

The rate of growth of micro-organisms is temperature dependant. However we cannot give a single temperature that fits the millions of types of micro-organisms. Some grow at chill temperatures (melting ice) and certainly a fair number grow at the temperature of the normal refrigerator (3^{o}C to 11^{o}C). Another group grow at intermediate range that is 15^{o}C to 40^{o}C. A further group grow at temperatures up to 55^{o}C and produce a spore that will survive boiling. (Some bacteria survive around underwater volcano cones at up to 500^{o}C).

As micro-organisms grow and reproduce they use up the components in food and produce their own waste materials. Therefore they alter the flavour of foods even making them smell or taste bad (spoilage). Sometimes they produce chemicals that are poisonous (toxic) to us. Others will infect our body cells. These are the food poisoning organisms (pathogens). These organisms typically (but not always) are best suited at the same temperature that we have, that is 37^{o}C.

Nearly all chemical processes slow down as we decrease the temperature. So whatever changes are taking place in foods will slow down as the temperature drops. The rough guide is that they slow down by a factor of 2 for every 10^{o}C drop in temperature. Alternatively, they speed up with every 10^{o}C rise in temperature.

So foods that normally store well at 4°C (in the fridge) for two weeks will only last one week at 14°C and only a few days at 24°C. By cooling the reverse is the case so cooling items will slow down the deterioration by the same degree. There are a few exceptions some fruits such as bananas and mangoes suffer damage if they are stored below 11°C.

However it is good practice to keep foods as cool as possible – at home, in the fridge, in the field, in the shade and the packhouse with plenty of draft.

Freezing

Freezing will stop deterioration of all foods but they will continue to deteriorate if the temperature is close to 0°C. The international standard for all foods is that they are stored at below -18°C at which all processes stop.

A SMALL NOTE THAT FRIDGES HAVE COOLING COILS ON WHICH WATER VAPOUR WILL CONDENSE ON THEM. IT IS IMPORTANT TO ENSURE THAT FOOD INTENDED FOR FREEZING IS WATER IMPERVIOUS (50 micron poly prolpylene at least) OTHERWISE THEY WILL DRY OUT

Finally the spoilage rate depends on numbers and although the numbers might be low at the beginning of preparation or handling numbers can reach very high numbers in a short time they can double their numbers in seven minutes. So good hygiene and prevention of access of vermin and flies defend food from contamination.

Chilled and Frozen Foods

Recommended temperatures and times for frozen foods storage are given in Table 1.

TABLE 1 CHILLED AND FROZEN FOODS STORAGE TIMES

Food		Refrigerator (4ºC/40ºF)	Freezer (-18ºC/0ºF)
Meat, poultry and eggs			
Fresh beef, veal, lamb, and pork	steaks	3-4 days	6-12 months
	chops	3-4 days	4-6 months
	roasts	3-5 days	4-12 months
Variety meats: tongue, liver, heart, and kidneys		1-2 days	3-4 months
Ham	cooked whole ham	7 days	1-2 months
	cooked half ham	6-7 days	1-2 months
	cooked slices	3-4 days	1-2 months
Hamburger and stew meat		1-2 days	2-4 months

Ground turkey, veal, pork, and lamb		1-2 days	3-4 months
Chicken and turkey	whole	1-2 days	1 year
	pieces	1-2 days	6-9 months
Giblets (heart, liver, kidney and gizzard)		1-2 days	3-4 months
Hot dogs (Use by 'Best Before' date)	opened package	1 week	2 weeks
	unopened package	2-3 months	2-3 months
Luncheon meat (Use by 'Best Before' date)	opened package	3- 5 days	1- 2 months
	unopened package	2 weeks	1- 2 months
Bacon and sausages (Use by 'Best Before' date)	bacon	7 days	1 month
	raw sausage (chicken, turkey, pork and beef)	1-2 days	2-3 months
Eggs	fresh raw	Use by 'Best Before' date	4 months (blended eggs)
	fresh yolk and white	2 - 4 days	4 months
	hard cooked eggs	1 week	Not recommended
Stew, soup or casseroles		3-4 days	2-3 months
Cooked duck or goose		3-4 days	2-3 months
Raw giblets		1-2 days	3-4 months
Fish			
Cooked fish		1-2 days	4-6 months
Fatty fish: mullet, ocean and sea perch, char, coral trout, striped bass, salmon, mackerel, bluefish and tuna		2-3 days	2-3 month
Ocean perch and sea trout		2-3 days	4 months
Fresh lean fish: cod, and perch		2-3 days	3-6 months
Smoked fish	Mahimahi, marlin	3-4 days	2 months
	Cold-smoked salmon and white fish	5-8 days	2 months
	Hot-smoked salmon and white fish	14 days	6 months
	Other smoked fish	1-2 weeks	4-5 weeks
Opened canned fish		1 day	Not recommended
Shellfish			
Lobster	Cooked	1-2 days	6-12 months
	Tails	1-2 days	6 months
Mana	Raw	1-2 days	6-12 months
	Cooked	3-4 days	3 months
Shrimp	Raw	1-2 days	6-12 months
	Cooked	3-4 days	3 months
Crab	Cooked	3-5 days	2 months
Scallops, vasua, kai and mussels	De-shelled (shucked)	1-2 days	3-4 months
Live oysters	De-shelled (shucked)	1-2 days	3-4 months
Opened canned shellfish		1 day	Not recommended

Leftovers and prepared foods			
Leftover cooked meat and poultry	meat and casseroles	3-4 days	2-3 months
	gravy and meat broth	3-4 days	2-3 months
	fried chicken	3-4 days	4 months
	poultry casseroles	3-4 days	4-6 months
	plain poultry pieces	3-4 days	4 months
	pieces covered with broth or gravy	3-4 days	6 months
Prepared salads	macaroni salad and tuna salad	3-5 days	Not recommended (does not freeze well)
Cooked stuffing		3-4 days	1 month
Soups and stews (with meat or vegetables)		3-4 days	2-3 months

Commonly freezers operate well but it is an offence to turn freezers off overnight. Chillers are often more difficult to control because of continuous access during meal preparation. Wherever possible high usage chillers should be set aside for continuous use items and a second chiller where continuous access is not necessary. Chilled foods should be stored at 4°C and frozen foods must be stored at -18°C which is an international standard.

About: Professor Richard Beyer

Dr. Richard Beyer is a prominent food technologist in the Pacific and considered a leader in food preservation. He is the author of over 15 commissioned reports relating to income generation and food security for the Pacific region. He has completed a textbook relating to the preservation and processing of root crops, bananas, plantain and breadfruit.

Dr. Beyer is available to consult with anyone interested in learning more about his work and he can be reached via email - richard.beyer1946@gmail.com